JACC: CARDIOVASCULAR IMAGING, VOL. 8, NO. 6, 2015
JUNE 2015:741–9

CMR can help differentiate between these malignant tumors. Tumor location in the right atrial wall and atrial appendage in a younger patient with central necrosis and possibly pulmonary metastasis favors angiosarcoma, whereas lymphomas appear in older patients with diffuse right atrioventricular involvement and RCA encasement and as solid tumors on CMR imaging. Although this is a small sample and features may depend on when the diagnosis was made in the natural history of the disease, it represents a significant number of biopsy-proven tumors with CMR correlation in these rare conditions. CMR may help noninvasive differentiation between angiosarcoma and lymphoma.

Geoffrey C. Colin, MD
Rolf Symons, MD
Steven Dymarkowski, MD, PhD
Bernhard Gerber, MD, PhD
Jan Bogaert, MD, PhD*

*KU Leuven–University of Leuven
Department of Imaging and Pathology
Medical Imaging Research Center
Herestraat 49
B-3000 Leuven
Belgium
E-mail: jan.bogaert@uzleuven.be

http://dx.doi.org/10.1016/j.jcmg.2014.08.011

Please note: Dr. Gerber has received research support from Philips Medical Systems. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

REFERENCE

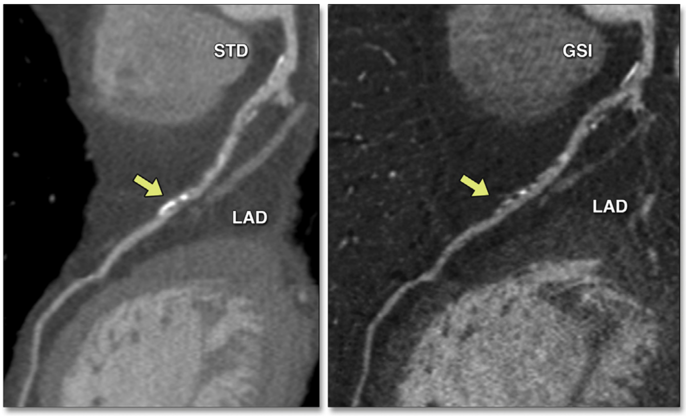
1. Butany J, Nair V, Naseemuddin A, Nair GM, Catton C, Yau T. Cardiac tumours: diagnosis and management. Lancet Oncol 2005;6:219–28.

APPENDIX For accompanying videos and their legends, please see the online version of this article.

Diagnostic Accuracy of Rapid Kilovolt Peak-Switching Dual-Energy CT Coronary Angiography in Patients With a High Calcium Score

Beam-hardening artifacts resulting from heavily calcified plaques in patients with a high coronary calcium score (CCS) may reduce coronary computed tomography angiography (CTA) diagnostic accuracy of the increased false-positive rate (1). A recently introduced computed tomography (CT) technology combines dual-energy computed tomography (DECT) with the latest gemstone detectors, made by a complex rare earth-based oxide that has a chemically replicated garnet crystal structure for gemstone spectral imaging (GSI) integrated into a 64-slice scanner (1). The scanner is equipped with an x-ray source that can switch energy rapidly. The datasets obtained from 2 different energies allow the reconstruction of material decomposed images (MDIs). Two studies demonstrated that coronary CTA using the new DECT offers improvement in terms of image quality compared with standard single-energy CT (1,2). The aim of the present study was to evaluate in patients with a high CCS (>400) the diagnostic accuracy of coronary CTA using DECT with monochromatic images and calcium removal by MDI compared with simulated conventional polychromatic image evaluation as a simulated standard of reference (sSTD) and compare the results with invasive coronary angiography (ICA). We enrolled 75 patients with indication for nonemergent ICA for suspected coronary artery disease (CAD), a CCS higher than 400, and a heart rate of ≤65 beats/min. Coronary CTA was performed with GSI-capable CT (Discovery HDCT 750, GE Healthcare, Milwaukee, Wisconsin) and the followings parameters: 64 × 0.625 mm and gantry rotation time of 0.35 s. Cardiac GSI can simultaneously acquire data by rapidly switching between 80 kVp and 140 kVp energies in <0.252 ms, which produces data that contain minimal misregistration artifacts. The beam was kept at 140 kVp for only a fraction (about one-third) of the radiation time to keep the radiation dose low, whereas during two-thirds of the scan time, the beam was switched to a lower tube current peak (80 kVp). A tube current of ≅600 mA was used. All scans were performed with prospectively electrocardiography-triggered acquisition. First, from the acquired DECT data, conventional polychromatic images that corresponded to a peak tube voltage ranging between standard values of 100 kV and 120 kV were simulated using a 77-keV monochromatic image and used as an sSTD. Second, MDI (iodine minus calcium) derived from the GSI data were used to represent the GSI. The Adaptive Statistical Iterative Reconstruction (ASIR) post-processing algorithm (set at 40%) was used for both types of image reconstruction (sSTD and GSI). The pre-test probability of CAD was intermediate to high (62%). Accordingly, the prevalence of obstructive CAD was 68% (51 of 75 patients). Of patients with ≥50% stenosis, 31 (61%) had multivessel CAD. The mean CCS was 606 ± 253. Eighty percent of patients were pre-treated with intravenous metoprolol before scanning, achieving a mean heart rate of 59 ± 5 beats/min. The mean effective dose was 0.87 mSv for CCS and 3.92 mSv for coronary CTA. The number of coronary segments with excellent image quality was significantly higher with

FIGURE 1 **Head-to-Head Comparison of STD and GSI Reconstruction**



LAD cardiac computed tomography angiography performed with a simulated STD **(left)** and after MDI **(right)**. Note the marked reduction of beam-hardening artifact due to a calcified plaque **(arrows)** by MDI. GSI = gemstone spectral imaging; LAD = left anterior descending artery; MDI = material decomposed image; STD = standard of reference.

GSI (57%) than with sSTD reconstruction (48%). The overall coronary evaluability was significantly higher after calcium removal compared with sSTD evaluation (98.2% vs. 94.9%) due to a lower number of severe artifacts (n = 21 vs. n = 61, respectively). In a subanalysis of artifacts, we found a significantly lower number of beam-hardening artifacts with MDI (n = 6) compared with sSTD (n = 46). In a segment-based analysis, coronary CTA sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy for more than 50% coronary stenosis identification were 100%, 99.3%, 93.8%, 100%, and 99.4%, respectively, with GSI and 100%, 95.9%, 66.4%, 100%, and 96.1%, respectively, with sSTD. Specificity, PPV, and accuracy were significantly higher with GSI compared with sSTD. In a patient-based analysis, coronary CTA sensitivity, specificity, PPV, NPV, and accuracy were 100%, 88.8%, 94.1%, 100%, and 96.2%, respectively, with GSI and 93.7%, 11.1%, 65.2%, 50% and 64.4%, respectively, with sSTD. Specificity, PPV, NPV, and accuracy were significantly higher with GSI compared with sSTD. Our study is the first to evaluate the diagnostic performance of coronary CTA performed with rapid kilovolt peak-switching DECT and MDI evaluation in patients referred for ICA. The main finding is that GSI technology allows a significant improvement of coronary CTA image quality, evaluability, and diagnostic accuracy versus simulated conventional polychromatic images reconstructed in the same patients (Figure 1). This remarkable improvement was the result of the combined use of monochromatic images at different energies, which per se determine beam-hardening reduction, as previously demonstrated, and calcium removal by MDI. Last, the radiation exposure of the new approach is substantially lower (mean effective dose <4 mSv).

Daniele Andreini, MD, PhD*
Gianluca Pontone, MD, PhD
Saima Mushtaq, MD
Erika Bertella, MD
Edoardo Conte, MD
Chiara Segurini, MD
Marta Giovannardi, MS
Andrea Baggiano, MD
Andrea Annoni, MD
Alberto Formenti, MD
Maria Petullà, MD
Virginia Beltrama, MD
Valentina Volpato, MD
Antonio L. Bartorelli, MD
Daniela Trabattoni, MD
Cesare Fiorentini, MD
Mauro Pepi, MD

*Centro Cardiologico Monzino
Via C. Parea 4
20138 Milan
Italy
E-mail: daniele.andreini@ccfm.it

http://dx.doi.org/10.1016/j.jcmg.2014.10.013

Please note: Dr. Pontone is on the Speakers Bureau of GE Healthcare, Bayer, HeartFlow, and Medtronic; and is a consultant for Heartflow. Dr. Andreini is on the Speakers Bureau of GE Healthcare. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

JACC: CARDIOVASCULAR IMAGING, VOL. 8, NO. 6, 2015
JUNE 2015:741–9

REFERENCES

1. Fuchs TA, Stehli J, Fiechter M, et al. First experience with monochromatic coronary computed tomography angiography from a 64-slice CT scanner with Gemstone Spectral Imaging (GSI). J Cardiovasc Comput Tomogr 2013;7:25–31.

2. Scheske JA, O'Brien JM, Earls JP, et al. Coronary artery imaging with single-source rapid kilovolt peak-switching dual-energy CT. Radiology 2013;268:702–9.

Extracellular Volume and Cardiac Mechanics: Have We Found a Missing Puzzle Piece?

We have read with great interest the recent report regarding increased cardiac extracellular volume (ECV) and impaired left ventricular (LV) mechanics in hypertensive patients (1). The study was innovative, and it may provide answers to many questions about left ventricular hypertrophy (LVH) and LV mechanics in hypertension. There are several important topics that deserve comment.

The investigators indicated that a small sample size was an obstacle for the evaluation of different effects: age, sex, diabetes, hypertension duration, and antihypertensive treatment. However, it would be useful to present at least the data regarding the use of medications, especially those that block the renin-angiotensin-aldosterone system or sympathetic nervous system. Cardiac extracellular matrix is significantly influenced by these biohumoral systems, so it is quite reasonable to hypothesize that these antihypertensive drugs influence ECV. In the present study, Kuruvilla et al. (1) reported that the non-LVH patients had significantly lower blood pressure levels than the LVH subjects. It is possible that this group had lower ECV because these patients were more often treated with renin-angiotensin-aldosterone system and sympathetic nervous system blockers.

Interestingly, the investigators did not provide data on the correlation between blood pressure level and ECV or native T1, a measurement of myocardial fibrosis. These results would be of interest because blood pressure could be a significant confounding variable in the relationship between ECV and LVH or between ECV and LV mechanics.

The investigators are not completely clear in terms of exclusion criteria. It seems that hypertensive patients with some common comorbidities, such as diabetes, obesity, and metabolic syndrome, were not excluded from the study. Investigations have previously shown that these risk factors are associated with cardiac extracellular matrix (2), and our study group demonstrated that these cardiovascular risk factors were associated with impairment of LV mechanics and increased LV mass (3). Therefore, inclusion of these risk factors certainly affects the relationship between ECV and LV mechanics. It would be useful to compare the levels of glucose and lipids, as well as body mass index, among the groups.

The investigators included patients with LV ejection fractions >45%, but they did not provide values of ejection fraction in different groups. Previous investigations have shown a strong correlation between LV mechanics and LV ejection fraction in hypertensive populations. Collins et al. (4) recently reported that ECV fraction was more closely associated with altered regional LV velocities than LV ejection fraction in patients with preserved ejection fraction, while Kuruvilla et al. (1) in the present study reveal the association between ECV and LV mechanics, without determination of the relation between ECV and LV ejection fraction. These findings may have opened a new era of LV function evaluation. Can we overcome LV ejection fraction in modern cardiac imaging?

Additionally, it would be interesting to investigate ECV in patients with different LVH patterns, concentric and eccentric. Previous studies have demonstrated significantly decreased 2-dimensional LV longitudinal, circumferential, and radial strain in hypertensive patients with concentric LVH compared with subjects with eccentric hypertrophy (5). The findings of the present study would potentially explain this difference.

Marijana Tadic, MD, PhD*
Cesare Cuspidi, MD
*University Clinical Hospital Center
"Dr. Dragisa Misovic - Dedinje"
School of Medicine
Belgrade University
Heroja Milana Tepica 1
11000 Belgrade
Serbia
E-mail: marijana_tadic@hotmail.com
http://dx.doi.org/10.1016/j.jcmg.2015.01.020

REFERENCES

1. Kuruvilla S, Janardhanan R, Antkowiak P, et al. Increased extracellular volume and altered mechanics are associated with LVH in hypertensive heart disease, not hypertension alone. J Am Coll Cardiol Img 2015;8:172–80.

2. Berk BC, Fujiwara K, Lehoux S. ECM remodeling in hypertensive heart disease. J Clin Invest 2007;117:568–75.

3. Tadic M, Cuspidi C, Majstorovic A, et al. Does the metabolic syndrome impact left-ventricular mechanics? A two-dimensional speckle tracking study. J Hypertens 2014;32:1870–8.

4. Collins J, Sommerville C, Magrath P, et al. Extracellular volume fraction is more closely associated with altered regional left ventricular velocities than left ventricular ejection fraction in nonischemic cardiomyopathy. Circ Cardiovasc Imaging 2015;8:e001998.

5. Mizuguchi Y, Oishi Y, Miyoshi H, Iuchi A, Nagase N, Oki T. Concentric left ventricular hypertrophy brings deterioration of systolic longitudinal, circumferential, and radial myocardial deformation in hypertensive patients with preserved left ventricular pump function. J Cardiol 2010;55:23–33.